3.6.9 PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY

Radiation Environment. Major sources and levels of background radiation exposure to individuals in the vicinity of ORR are shown in Table 3.6.9–1. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to ORR operations.

Table 3.6.9–1. Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Oak Ridge Reservation Operation

Source	Effective Dose Equivalent (mrem/yr)
Natural Background Radiation[a]	
Cosmic radiation	27
External terrestrial radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fall out	<1
Air travel	1
Consumer and industrial products	10
Total	360

[a] OR DOE 1994c.
[b] NCRP 1987a.
Source: Value of radon is an average for the United States.

Releases of radionuclides to the environment from ORR operations provide another source of radiation exposure to individuals in the vicinity of ORR. Types and quantities of radionuclides released from operations in 1993 are listed in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). Doses to the public resulting from these releases and direct radiation are presented in Table 3.6.9–2. These doses fall within radiological limits (DOE Order 5400.5) and are small in comparison to background radiation. The releases listed in the 1993 report were used in the development of the reference environment (No Action) radiological releases and resulting impacts at ORR in the year 2005 (Section 4.2.5.9).

Based on a risk estimator of 500 cancer deaths per 1 million person-rem to the public (Section M.2.1.2), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1993 is estimated to be 1.5×10^{-6}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of ORR operations is less than 2 in 1 million. (Note that it takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Based on the same risk estimator, 0.014 excess fatal cancers are projected in the population living within 80 km (50 mi) of ORR from normal operations in 1993. To place this number into perspective, it can be compared with the number of fatal cancers expected in this population from all causes. The 1990 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Almanac 1993a:839). Based on this national rate, the number of fatal cancers expected to occur during 1993 from all causes was 1,760 for the population living within 80 km (50 mi) of ORR. This number of expected fatal cancers is much higher than the estimated 0.014 fatal cancers that could result from ORR operations in 1993.

Table 3.6.9–2. Radiation Doses to the Public From Normal Oak Ridge Reservation Operation in 1993 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	1.4	4	0.60[b]	100	3.0[c]
Population within 80 km[d] (person-rem)	None	26	None	2.0	100	28.0
Average individual within 80 km[e] (mrem)	None	0.030	None	0.0023	None	0.032

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that order, the 10 mrem/yr limit from airborne emissions is required by the CAA, the 4 mrem/yr limit is required by the SDWA, and the total dose of 100 mrem/yr is the limit from all pathways combined. The 100 person-rem value for the population is given in proposed 10 CFR 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.

[b] These doses are mainly from drinking water and eating fish from the Clinch River section of Poplar Creek.

[c] This total dose includes 1 mrem/yr from direct radiation exposure to a cesium field near the Clinch River.

[d] In 1993, this population was approximately 880,000.

[e] Obtained by dividing the population dose by the number of people living within 80 km of the site.

Source: OR DOE 1994c.

Oak Ridge Reservation workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. Table 3.6.9–3 presents the average worker, maximally exposed worker, and cumulative worker dose to ORR workers from operations in 1992. These doses fall within radiological regulatory limits (10 CFR 835). Based on a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Section M.2.1.2), the number of fatal cancers to ORR workers from normal operations in 1992 is estimated to be 0.027.

Table 3.6.9–3. Radiation Doses to Workers From Normal Oak Ridge Reservation Operation in 1992 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average worker (mrem)	ALARA	4.0
Maximally exposed worker (mrem)	5,000	2,000
Total workers[b] (person-rem)	ALARA	68

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable.

[b] The number of badged workers in 1992 was approximately 17,150.

Source: 10 CFR 835; DOE 1993n:7.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Oak Ridge Reservation Environmental Report for 1993* (ES/ESH-47). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in the same report.

Chemical Environment. The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain

hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (for example, surface waters during swimming and soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in previous sections of this PEIS, particularly Section 3.6.3.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (for example, air emissions and NPDES permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations via inhalation of air containing hazardous chemicals released to the atmosphere by ORR operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are low relative to the inhalation pathway.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data presented in Section 3.6.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations. Information about estimating health impacts from hazardous chemicals is presented in Section M.3.

Exposure pathways to ORR workers during normal operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a meaningful estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. ORR workers are also protected by adherence to OSHA and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals utilized in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements (DOE O 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at ORR are expected to be substantially better than required by the standards.

Health Effects Studies. Two epidemiologic studies were conducted to determine whether ORR contributed to any excess cancers in communities surrounding the facility. One study found no excess cancer mortality in the population living in counties surrounding ORR when compared to the control populations located in other nearby counties and elsewhere in the United States. The other found slight excess cancer incidences of several types in the counties near ORR, but none of the excess risks were statistically significant.

A pilot study on mercury contamination conducted by the Tennessee Department of Health and Environment showed no difference in urine or hair mercury levels between individuals with potentially high mercury exposures compared to those with little potential for exposure. However, soil analysis showed that the mercury in soil was inorganic, which decreases the likelihood of bioaccumulation and health effects. Studies are continuing on the long-term effects of exposure to mercury and other hazardous chemicals.

More epidemiologic studies have been conducted to assess the health effect of the population working at ORR than any other site reviewed for this document. Excess cancer mortalities have been reported and linked to specific job categories, age, and length of employment, as well as to the levels of exposure to radiation. For a more detailed description of the studies reviewed and the findings, refer to Section M.4.6.

Accident History. There have been no accidents with a measurable impact on offsite population during nearly 50 years of Y–12 operations at ORR. The most noteworthy accident in Y–12 history was a 1958 criticality accident. The impact from this accident resulted in temporary radiation sickness for a few ORR employees. In 1989, there was a one-time accidental release of xylene into the ORR sewer system with no offsite impacts.

Accidental releases of anhydrous hydrogen fluoride occurred in 1986, 1988, and 1992, with little onsite and negligible offsite impacts. The hydrogen fluoride system where these accidents occurred is being modified to reduce the probability of future releases and to minimize the potential consequences if a release does occur (ORR 1992a:6).

Emergency Preparedness. Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response for most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

The Department has overall responsibility for emergency planning and operations at ORR. However, DOE has delegated primary authority for event response to the operating contractor. Although the contractor's primary response is onsite, the contractor does provide offsite assistance if requested under the terms of existing mutual aid agreements. If a hazardous materials event with offsite impacts occurs at a DOE ORR facility, elected officials and local governments are responsible for the State's response efforts. The Governor's Executive Order No. 4 established the Tennessee Emergency Management Agency as the agency responsible for coordinating State emergency services. When a hazardous materials event occurring at DOE facilities is beyond the capability of local government, and assistance is requested, the Tennessee Emergency Management Agency Director may direct State agencies to provide assistance to the local governments. To accomplish this task and ensure prompt initiation of emergency response actions, the Director may cause the State Emergency Operations Center and Field Coordination Center to be activated. City or county officials may activate local Emergency Operations Centers in accordance with existing emergency plans.